STANDARD FOR GRASSED WATERWAYS

Definition

A natural or constructed watercourse shaped or graded in earth materials and stabilized with suitable vegetation for the safe conveyance of runoff water.

Purpose

To provide for the conveyance of excess surface water without damage by erosion or flooding.

Conditions Where Practice Applies

This practice applies to sites with drainage areas less than 200 acres where concentrated runoff requires vegetative protection or stone center lining to control erosion. Slope of waterway must be less than 10%. Some of the other practices that may be required with this practice are: (1) grade control structures, (2) subsurface drainage to permit the growth of suitable vegetation and to eliminate wet spots, (3) a section stabilized with stone or other material within the waterway or (4) buried storm drain to handle frequently occurring storm runoff, base flow or snowmelt. This practice is not appropriate when maintenance of the grass lining cannot or will not be performed.

Water Quality Enhancement

Use of this standard will provide protection of the waterway lining from the erosive forces of flowing water. Additionally, stormwater runoff quality may be enhanced through adsorption and infiltration (absorption) of minor suspended solids and associated pollutants, such as excess fertilizers and pesticides, hydrocarbons and through bacterial degradation of biosolids. Minor groundwater recharge may also be provided. The total effect on water quality is limited by higher flow velocities and concentrated flows in the waterway. Swales should not be depended upon to provide the sole means of improving runoff water quality. They should be used in conjunction with other erosion control practices listed in these standards, whenever possible.

Design Criteria

Capacity

Peak discharge values shall be determined by the following:

1. Rational Method - for peak discharge of uniform drainage areas as outlined in Technical Manual for Land Use Regulation Program, Bureau of Inland and Coastal Regulations Stream Encroachment Permits, Trenton, N.J. September 1997 or subsequent editions.

2. USDA-NRCS Win TR- 55 or Win TR-20.

3. U.S. Army Corps of Engineers HEC HMS

4. Other methods which produce similar results to the models listed above.

Minimum capacity and maximum velocity shall be based on the 10 year frequency storm, unless a larger storm event is to be conveyed for reasons of safety, compatibility with other stormwater management measures etc.

Velocity

The maximum allowable velocity for design flow will be determined by the most erodible soil texture exposed and the type of vegetation expected and maintained in the channel. As a stable design the waterway shall meet the following allowable velocity criteria and shall not be designed within 10% of critical flow (Froude number = 0.90). .

Table 18-1 Maximum Allowable Velocities by Soil Texture

SOIL TEXTURE	Maximum Allowable Velocity (fps)	
	Seeded Vegetation**	Sod***
Sand	2.0	3.0
Silt loam, sandy loam, loamy sand, loam, muck	2.0	3.0
Silty clay loam, sandy clay loam	2.5	4.0
Clay, clay loam, sandy clay, silty clay	3.0	5.0

Maximum Allowable Velocities are based on flow of clear water.

** Maximum allowable velocities for channels stabilized by seeding may be increased according to the type of Flexible Channel Liner used as shown in the following table. These velocities may be added to the allowable velocities shown above, except for sands.

***On well to excessively drained soils, most cool season sod types will not survive without continued irrigation. Placement of sod in such areas must be approved by the District.

Table 18-2 Classification of Flexible Channel Liners by Texas DOT

"Class 2" Flexible Channel Liner Designation [1]	Allowable Shear Stress[2] (psf)	Incremental increase in velocity (fps)
Type "E"	0 to 2	1.0
Type "F"	0 to 4	1.5
Type "G"	0 to 6	2.0
Type "H"	0 to 8	3.0
Type "I"	0 to 10	4.0
Type "J"	0 to 12	5.0

[1] Designations defined by Texas Department of Transportation Hydraulics and Erosion Control Laboratory Field Performance Testing of Selected Erosion Control Products (as amended or most current) Evaluation Cycle

[2] Typically refers to maximum stress with a fully vegetated matting

There shall be no increase in allowable velocity beyond that indicated for sod if the design life of the flexible channel liner is less than the planned service life of the grassed waterway.

Vegetative Retardance Factors and Manning's "n" Value

The minimum capacity and maximum velocity shall be determined by using the appropriate vegetative retardance factors listed below. Appendix A2 contains examples and charts for use in design. Agricultural Handbook No. 667, Stability Design of Grass-Lined Open Channels, may also be used to design grass waterways based on tractive stress.

Vegetative Retardance Factors

Minimum for Capacity - "D"

Maximum for Allowable Velocity - "E"

Tables to select channel dimensions are available in Appendix A11, Ref. #1, Chapter 7.

Dimensions

The dimensions of the waterway will be based on: (1) the minimum required for capacity, the channel slope, the maximum permissible velocity, the vegetation, the soil; (2) ease of crossing and maintenance; and (3) site conditions such as water table, depth to rock or possible sinkholes.

The minimum top width of a waterway will be 10 feet. The maximum design top width shall not exceed 50 feet.

The minimum design flow depth shall be sufficient to completely submerge the vegetative lining during the design flow (consideration may be given to expected mature height undergoing deflection during flow or an artificially maintained height) such that uniform flow characteristics are achieved. Design flow depths which are less than the lining height may tend to produce meandering and erosion in the waterway bottom and will not be accepted.

The cross section may be parabolic, vee-shaped, or trapezoidal. Cross-section(s) and profile(s) of all grassed waterways shall be submitted on the Soil Erosion and Sedimentation Control Plan.

Drainage

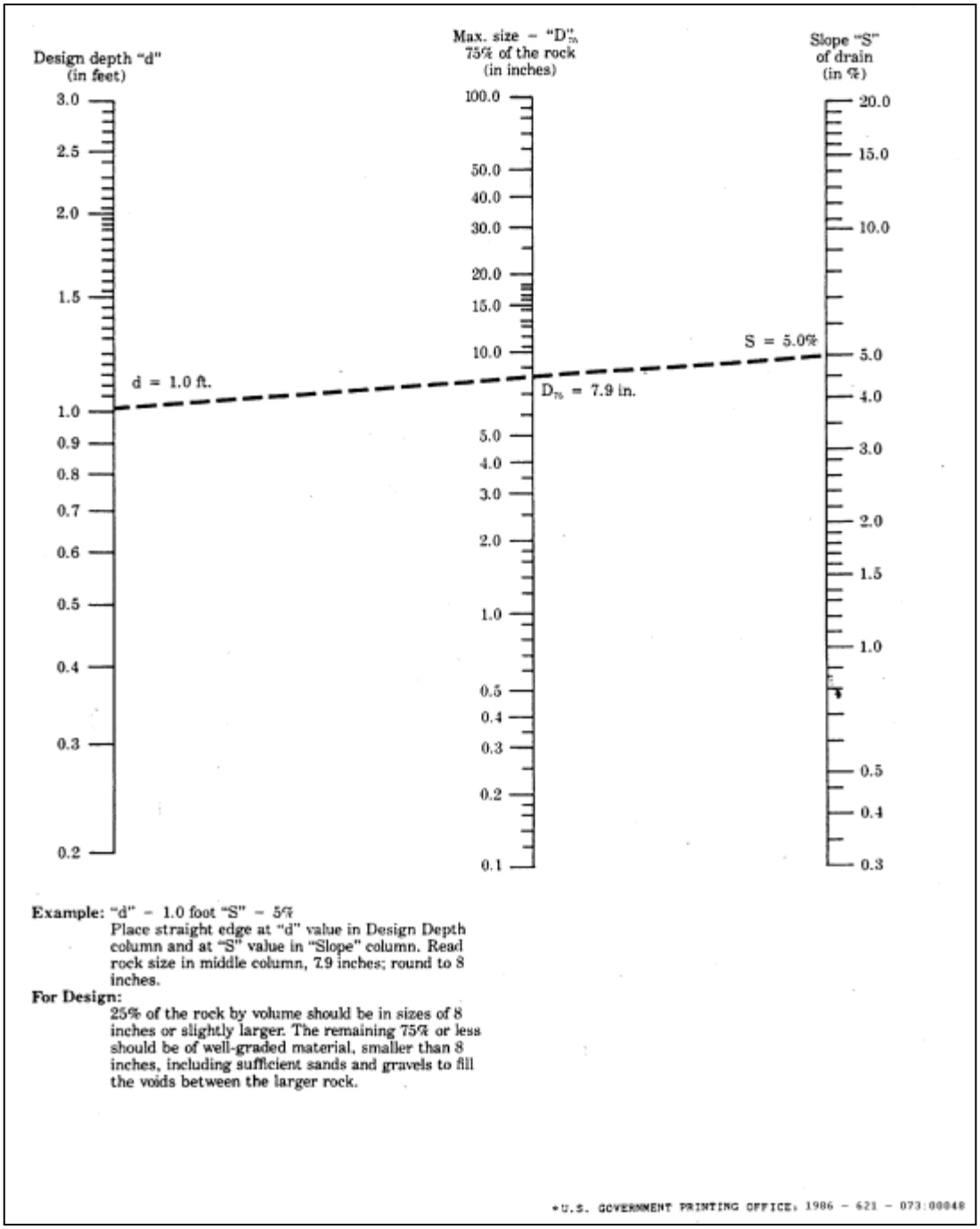
In areas with low flow, high water table or seepage problems, underdrains, stone centers or other subsurface drainage methods are to be provided. A minimum drainage coefficient of ½ inch in 24 hours is to be used for underdrain design. An open joint storm drain may be used to serve the same purpose and also handle frequently occurring storm runoff, base flow or snowmelt. The storm drain shall be designed to handle base flow, snowmelt or the runoff from at least a one-year frequency storm, whichever is greater.

Design of Stone Center lining for wet or low flow conditions:

Where a stone lining is needed due to seepage, low flow, high water table, etc.,stone size shall be based on the maximum design flow (10 year storm event minimum) to be conveyed and shall be installed to a depth equal to the design flow depth for a 1 year, 24 hour storm. The stone shall be **EMBEDDED FLUSH** with the waterway surface.

The following nomograph may be used to determine the D_{75} stone size for the center lining:

Nomograph to Compute Stone Size for Grass Waterway Center Lining



Example: "d" – 1.0 foot "S" – 5%
Place straight edge at "d" value in Design Depth column and at "S" value in "Slope" column. Read rock size in middle column, 7.9 inches; round to 8 inches.

For Design:
25% of the rock by volume should be in sizes of 8 inches or slightly larger. The remaining 75% or less should be of well-graded material, smaller than 8 inches, including sufficient sands and gravels to fill the voids between the larger rock.

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Outlet

The outlet must handle the design flow without flood damage. The outlet must be stable for the 10-year storm.

Vegetation - Permanent Cover

A permanent vegetative cover shall be established on all grassed waterways in accordance with the Standard for Permanent Vegetative Cover for Soil Stabilization or Standard for Permanent Stabilization with Sod. Where the season and other conditions may not be suitable for growing permanent erosion resistant cover, erosion protection will be provided in accordance with the Standard for Temporary Vegetative Cover for Soil Stabilization or by the use of a Class 2 Flexible Channel Liner as described above. The seeding will extend to at least the design top width.

Installation Requirements

Construction

Trees, brush, stumps and other material in objectionable amounts are to be cleared and disposed of so as not to interfere with construction or proper functioning of the waterway.

Fills are to be compacted as needed to prevent unequal settlement that will cause damage in the completed waterway. Where deep cuts are made into the subsoil, consideration shall be given to adding organic soil amendments or topsoil.

Vegetative Lining

Waterways or outlets shall be protected against erosion by vegetative means as soon after construction as practical and before diversions or other channels are outleted into them. Consideration should be given to the use of a flexible channel liner or sodding channels to provide erosion protection as soon after construction as possible.

Seeding, fertilizing, mulching and sodding shall be in accordance with the applicable Standards.

Maintenance

Routine maintenance of the vegetative lining, including mowing, liming and fertilizing must be performed to ensure that the waterway continues to perform as designed (see the Standard for Maintaining Vegetation). If maintenance cannot be or is not planned to be performed an alternate means of waterway stabilization or means of runoff conveyance should be considered.